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ABSTRACT

Six major reports have recently assessed the state of the world in terms of energy, food, population, natural resources, pollution, and economic development. These reports include: (1) "The Global 2000 Report to the President: Entering the Twenty-First Century"; (2) "Global Future: Time to Act"; (3) "World Conservation Strategy: Living Resource Conservation for Development"; (4) "Interfutures: Facing the Future"; (5) "North-South: A Programme for Survival"; and (6) "World Development Report." Findings and recommendations of these reports serve as the basis for the summary of selected environmental prospects. Although the findings/recommendations are not identical, with differences of focus and emphasis, all conclude that there are serious problems ahead environmentally and economically, and while solvable, they will require more and better planning. Areas addressed include: population (migration, international migration); energy resources (demand/supply, fuelwood, transition from oil-based systems); mineral resources (mineral reserves, distribution of minerals); food (food production, ecological considerations, fisheries, food prospects); and future prospects. Also included are excerpts from books by Herman Kahn and Julian Simon (who see difficult times ahead economically/environmentally), followed by commentaries of demographers or economists. (JN)

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THE ENVIRONMENT TO COME:

A GLOBAL SUMMARY

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THE ENVIRONMENT TO COME: A GLOBAL SUMMARY

by Elaine M. Murphy

It is hard to know what to believe. One year people wait in long lines at gas stations and then—suddenly it seems—all the news is about an "oil glut." Is there an oil crisis or not?

Or, we read about coming famines in one place, and in another we read about paying farmers *not* to grow food. We hear, too, success stories about cleaning up lakes, rivers, and air quality, but elsewhere we hear dire predictions of possibly irreversible pollution. Some say we are running out of resources while others say there are inexhaustible supplies.

The citizen, at the mercy of differing and sometimes polarized views of the state of the world's environment, often feels bewildered, frustrated, and finally paralyzed. Without a trustworthy source of information, attitudes cannot be formed, and without clear attitudes, activities—personal or political—will not be undertaken.

This material tries to deal with the understandable confusion of the layperson. Since there is no way to ascertain the "truth" about the present and likely future state of the global environment, we feel the best approach is to look for a consensus of experts on the issues. In the past few years, several major reports have assessed the state of the world in terms of energy, food, population, natural resources, pollution, and economic development. This summary is based on the findings and recommendations of these major reports. We will also consider generally dissident views such as those of Herman Kahn's *The Next 200 Years* and Julian Simon's *The Ultimate Resource.*

New Perceptions

In the decade or so since the beginnings of "the environmental movement," the perception of environmental problems has matured. Those who studied any aspect of the problem soon realized that one aspect was inextricably bound to other aspects as well as to social, economic, and political factors. People came to see that the world is truly a system and is not the sum of its parts. It is interconnected, dynamic, and changing. It appears to be governed by feedback mechanisms, subsequent adjustments, and thresholds. The political, economic, and environmental subsystems are thus self-regulating—up to a point. Past that point we have breakdowns, such as wars or revolutions, financial depressions, "dead" bodies of water or desertification.

The issue of food and hunger is a good case in point. In an earlier day it seemed that there simply was not enough land for the number of people to be fed. That was too simple an explanation. We know now that in addition to the amount of land and rate of population growth in various parts of the world, other factors are crucial: miracle seeds, fertilizer, pesticide and water "inputs," modern farming machinery and techniques, the cost of oil for the machinery, the availability of credit for farmers, the market price for products, the cost of importing food compared to export profits, land ownership patterns, government investment in agriculture, population distribution, environmentally sustainable or unsustainable practices, helpful or unhelpful foreign aid.

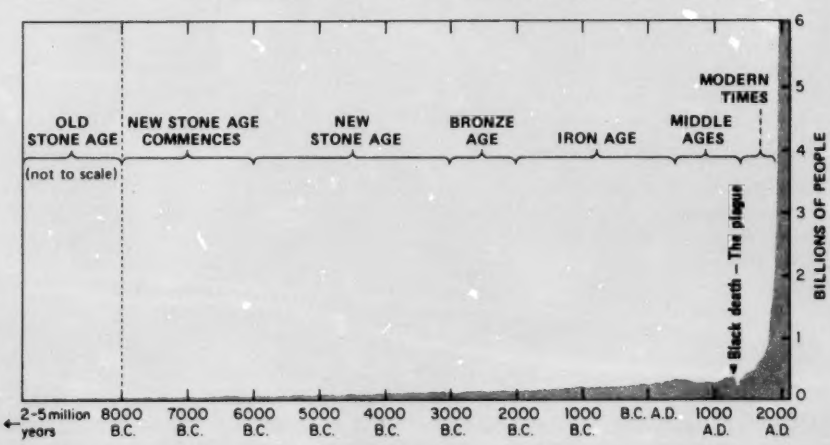
Poverty is a chief culprit: where people are too poor to improve their farm output through modern techniques or too poor to purchase food, there will be hunger. Here the poverty and population growth feedback loop is clear as well: too poor to purchase the agricultural innovations that will increase the yield per hectare,* poor farm families need many children to help on the farm. Many children will also ensure that the parents will be taken care of in their old age. (The governments of many developing countries are too poor to offer social security programs.) When the children grow up there is not enough land for all of them to farm, and in the aggregate the population growth which results from many large families overwhelms the government's ability to provide basic services, let alone to invest adequately in agriculture. Nor can it then finance the social security programs that would reduce motivation for large families.

One model for such a system is a billiards game. A major change in one factor—such as the price of oil—is a hurtling ball which strikes the others: food production, poverty, inflation, jobs, transportation, conservation among many others. They in turn hit others including the original price-of-oil ball and when things finally settle down, we discover significant realignments.

Although they emphasize the con-

*A hectare is 2.47 acres or 10,000 square meters.

Figure 1. World Population Growth Through History



POPULATION REFERENCE BUREAU

cept of interrelatedness, the global reports do look at particular problem areas. For the purpose of this review, we can only summarize the common findings in a few of these areas—population, energy, mineral resources, and food.

POPULATION

Population trends will be one of the strongest forces shaping the future of human society. In the last quarter of the 20th century it appears inevitable that the world's population will grow by 50 percent—from four billion in 1975 to six billion in 2000. This will happen, in spite of recent dramatic decreases in birth rates in many developing countries, because of the built-in momentum of population growth. Due to past high fertility, there are now large numbers of people in the childbearing years who, even at reduced birth rates, will collectively produce large numbers of children.

About 90 percent of the population growth will occur in the low income countries, those already experiencing food scarcities, massive rural-urban migration, inadequacies in housing, health care, and education, and high unemployment, particularly among youth.

In the developing countries, rapid population growth is straining food production and is increasing the number of the landless poor. Biological resources—water, soil, forests, wildlife, oceans, genetic diversity—are threatened by continued population pressure. Population growth exacerbates existing economic, social, and ecological problems and undermines otherwise successful efforts to solve problems such as hunger, poverty, and unemployment. Continued rapid population growth in poor countries can prevent the benefits of economic development from reaching the poor; development—if it benefits the poor—helps to reduce birth rates. But even a pie that is twice as large as the old one will feed an individual no better if there are also twice as many people sharing the pie.

Migration

The migration of people from the countryside to urban areas is another critical population issue. The world is becoming ever more "citified." As we enter the 21st century, half of the world's population will live in cities, for the first time in history. Cities themselves are larger than ever; by 2000 there will be 25 cities or "urban agglomerations" with over 10 million people. Five of them will be over 22 million.

The cities of the developing countries are growing faster than their total populations are growing. The rural-to-urban migration is in part due to the "pull" of urban industrialization and its jobs, and in part to the "push" of poverty and rapid population growth in the rural areas. Rapid migration to the cities puts strains on urban services such as housing, health, education, waste disposal, transportation, communications, and security. It often holds down urban wages by increasing the number of people seeking jobs and adds to the large number of the unemployed and underemployed. However, in spite of the fact that many migrants end up jobless and living in squalor, on balance, those who move tend to be better off than the rural poor they left behind.

International Migration

There are about 20 million workers who have left their own countries to work in others. This large-scale movement, particularly in the last decade, reflects the differences in income and employment opportunities among the sending and receiving countries.

Refugees and immigrants represent another significant flow of people from one country to another. Hundreds of thousands have been uprooted by war, revolution, and by political or religious oppression. In the last

THE GLOBAL REPORTS

The findings and recommendations of the following six reports form the basis for this summary of selected environmental prospects. These reports deal with many more topics than the few we can deal with in this description. The findings and recommendations of the reports are not identical; there are differences of focus and emphasis. However, all conclude that there are serious problems ahead environmentally and economically, and while solvable, they will require much more and much better planning and cooperation. All agree that the current course of events must be altered.

1. The Global 2000 Report to the President: Entering the Twenty-first Century.

Published by the U.S. Government Printing Office in 1980, this is a major study presented in three volumes. Volume One is the Summary Report. Volume Two is the Technical Report which details the findings, and Volume Three provides technical documentation regarding the government's global models.

In 1977, then-President of the United States Jimmy Carter issued a directive to the Council on Environmental Quality and the Department of State to study the probable changes in the world's population, natural resources, and environment through the end of the century. The study would serve as a foundation of longer-term planning.

The *Global 2000 Report* emphasizes the interdependence of population, resources, and environment. However, it admits to inconsistencies and contradictions due to insufficient consideration of linkages among the sectors of the model it employs. "The inescapable conclusion is that the omission of linkages imparts an optimistic bias to the Global 2000 study's (and the U.S. Government's) quantitative projections."

2. Global Future: Time to Act

Published by the U.S. Government Printing Office in 1981, this report is the "next step" following completion of the *Global 2000 Report*. The *Global 2000 Report* concluded in its now famous first sentence: "If the present trends continue, the world in 2000 will be more crowded, more polluted, less stable ecologically, and more vulnerable to disruption than the world we live in now."

The President of the U.S. then directed the Council on Environmental Quality and the Department of State to look at government programs related to the global trends described, assess their effectiveness, and recommend improvements. *Global Future: Time to Act* is the study which resulted. It is organized by topics (population, food and agriculture, renewable energy resources...) and describes briefly the problem, U.S. interests, current U.S. strategy in dealing with problems, and recommendations.

3. World Conservation Strategy: Living Resource Conservation for Development

This report was published in 1980 by the International Union for the Conservation of Nature and Natural Resources (IUCN) with guidance and financial support from the United Nations Environment Programme (UNEP) and the World Wildlife Fund. Also collaborating were the Food and Agriculture Organization of the U.N. (FAO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO).

The goal of the World Conservation Strategy is to integrate the concerns of both conservation and development so that "modifications to the planet do indeed secure

the survival and well-being of all people." The title proclaims its goal: to conserve the earth's living resources by choosing development plans which are sustainable in terms of natural resources. To draft the report, 450 government agencies and conservation organizations were polled to elicit their views on conservation and development.

4. Interfutures: Facing the Future

The Organisation for Economic Co-operation and Development (OECD) published this report in 1979 after a three-year study. The OECD membership consists of the countries of Western Europe, Turkey, Australia, New Zealand, the United States, and Japan; its headquarters are in Paris.

The Interfutures project began because of member countries' concern about economic difficulties in the developed nations, the gap between the developed and developing countries' economies and "the question of whether and how it will prove possible to ensure future prosperity and balanced economic and social development in harmony with the developing countries."

The report envisions different futures that could result from the behavior of the "actors" involved within the limits of the systems through which they act. It takes into consideration the projects which the actors might undertake to create new solutions to problems. Thus, the report consists of a set of possible scenarios for future economic development, given relationships among developed nations, and among developed and developing nations.

5. North-South: A Programme for Survival

Published in 1980 by MIT Press, *North-South* is the report of an independent commission chaired by Willy Brandt, former Chancellor of West Germany. The other members of the Independent Commission on International Development Issues were chosen for a broad range of expertise and perspectives.

The Commission's mandate: "to study the grave global issues arising from the economic and social disparities of the world community and to suggest ways of promoting adequate solutions to the problems involved in development and in attacking absolute poverty."

The report offers both a short-term—through the 1980s—and a longer-term—through 2000—program for changes in international economic relations. The topics addressed are predominantly economic (e.g., monetary reform), but population and environment, disarmament, and hunger and food are part of the set of interacting variables.

6. World Development Report

Published in 1982 by the World Bank, this fifth *World Development Report* emphasizes the importance of continued expansion of the economies of the developing countries if poverty is to be reduced. The first part deals with international development trends: the world economy in transition, long-term development trends, and prospects for the 1980s. Part Two is a detailed analysis of agriculture and economic growth, the sources of agricultural growth, and the role rural poverty plays in food and hunger problems. The *World Development Report* stresses the importance of agricultural policy changes, education and training, improved health and nutrition, and fertility reduction, not only to meet basic needs, but also as important components of economic growth.

decade, millions of people have willingly emigrated to the more prosperous countries; many have done so illegally. While immigration often benefits the receiving countries in several ways, those countries must provide for immigrants' consumption of food, minerals, and energy (as well as jobs, housing, and other services).

ENERGY RESOURCES

"The future now is unknown and unclear," according to Mana Saeed Oteiba, oil minister of the United Arab Emirates.[1] This statement was made on January 27, 1983, following the collapse of OPEC (Organization of Petroleum Exporting Countries) meetings in Geneva, called to discuss solutions to the recent oil glut. In terms of energy prospects, almost everyone in the world would agree with him.

Demand and Supply

World energy demand—a combination of population growth, industrialization, and rising standards of living mostly in developing countries—is projected by some experts to rise more than 50 percent between 1975 and 1990. Oil will continue to be the single largest source of energy, still providing about 46 percent of total energy consumed, followed by coal (20 percent), natural gas (17 percent), and nuclear and hydropower (16 percent). Nuclear and hydro sources will increase most rapidly, doubling their share of the energy market. By 1990, solar power will still be negligible.

These proportions assume that there will be an increase of 65 percent in the real cost of oil over the 1975-1990 period. If the cost is higher, perhaps due to an OPEC pricing agreement, the proportion of oil consumed might go down and other energy sources will rise; if the price is lower, perhaps also due to an agreement about raising production, the share could rise. At this point, oil gluts and scarcity are due to political decisions—the decisions by oil producers to produce more or less, to fix prices, or to undercut their competitors. The reduction in consumption and increase in domestic production by oil importing countries following the oil crisis of the early 1970s show that the exporters are not the only players in the game.

Does this mean that oil is plentiful for the foreseeable future? No. According to engineering and geological studies, and apart from political manipulations, world petroleum production should peak by the end of this century. While prices will fluctuate according to political decisions, the trends will be ever upward. Yet to increase global food production in the coming decades, there will be an increased reliance on petroleum and petroleum-related products which are decreasing in availability and increasing in price. Even if offshore oil recovery is expanded, successes will not buy much time.

Theoretically the finite fuel sources—coal, natural gas, oil shale, tar sands, and uranium, in addition to oil—are sufficient for the next century or more. However, they pose a variety of economic and environmental problems. The production of oil from oil shale, for example, requires a great deal of water and produces a great deal of waste. The burning of coal and other fossil fuels is associated with acid rain which damages soil, crops, fresh water organisms, forests, and building materials. Fossil fuel burning also contributes to a buildup of carbon dioxide (CO_2) in the atmosphere which may lead to a warming of the climate, altered patterns of rainfall and snow, disruption of agriculture, and the possibility of melting the polar ice caps, thus raising sea levels.

Fuelwood

While the industrial world is using up the dwindling supplies of oil and other fossil fuels, poor people who cannot afford oil products for cooking and heating turn increasingly to their

[1] *Washington Post*, January 28, 1983, p. A22.

traditional source, fuelwood. An estimated 1.5 million people in developing countries rely on wood as their primary energy source. However, population pressure is turning this once-plentiful resource into a scarce resource, with demand likely to exceed the supply by 25 percent by the end of the century.

Fuelwood which is for sale has become expensive as a result of its scarcity. Thus poor people turn more and more to gathering their own wood, removing protective ground cover, and chopping down trees. The resulting deforestation, especially when compounded by felling trees for building or selling, results in flooding—devastating crops and homes. Others burn animal dung and crop residues for fuel instead of applying it to the land as fertilizer. The soil is degraded and less food is produced. One big choice for the future seems to be: food or fuel?

The Transition

Because at current rates of usage oil and natural gas will be depleted in the coming decades, the world has begun a shift to other sources of energy, particularly renewable sources. Most efforts are concentrated on nuclear power and hydropower (harnessing the power of falling water), although development of coal, oil shale, and oil sands continues, and there are efforts in solar, wind, and geothermal power, biomass,* and synthetic fuels.

The transition away from oil is difficult because oil is an unusually versatile energy source which can be used for many different purposes (running machinery, powering cars and trucks, heating homes). It is easy to store and to transport and is highly concentrated. Industrial society is geared to its convenient liquid form. The transition to other forms of energy is not merely a matter of extraction or production; it is also a matter in many cases of adapting or changing the machines involved as well as methods of storage and transportation.

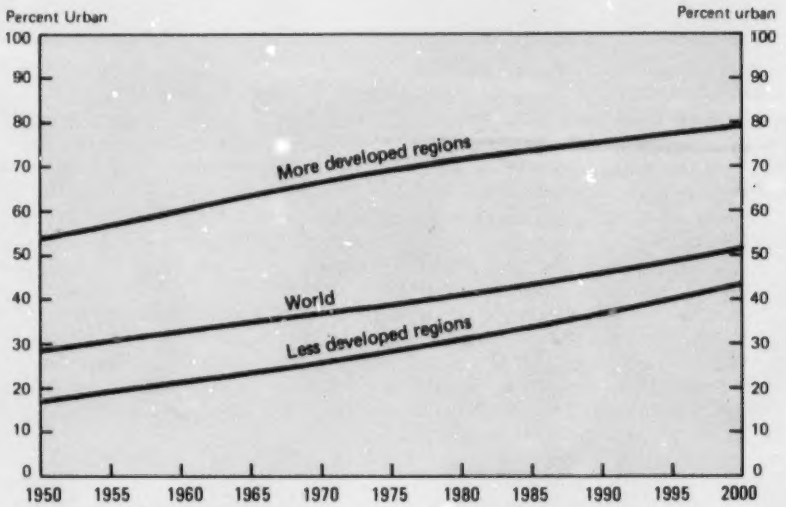
The length of the period of transition from an oil-based system to future systems is estimated to be at least 50 years, and probably more. In the long run, the new energy resources should be sufficient for the world's ultimate energy demands which will probably be 10 to 15 times greater than the 1975 demand. The great unknown concerns the transition period (we are in it now) which requires unprecedented foresight, planning, and international cooperation.

Even those confident of the technical availability of energy in the future describe this transition period as marked by great uncertainties. They are concerned that various types of crises with serious consequences may emerge in the next 25 years. The difficulties of meeting the challenges of this crucial period are both economic and political. Within nations, the public may not understand the urgency of taking measures now, even though for the short-term there are no scarcities. At the international level we must overcome real differences, or perceived differences, of self-interest between groups of nations.

One of these differences is the "consumption gap." Between 1975 and 2000, energy consumption will, according to one study, almost double for the industrial countries; for the developing countries, it will be five to seven times their 1975 level. Nonetheless, the developed countries will still consume seven times more energy per capita than the developing countries. The question "energy develop-

*Biomass is the amount or weight of living matter, but here refers to the combustion of living matter (e.g., peat, corn, etc.).

Figure 2. World and Regional Urban Population, 1950-2000



Source: Population Division, United Nations.

Table 1. Regional Distribution of Global Energy Use, 1975 and 1990

	1975 Annual Use		1990 Annual Use			
	10^{15} Btu	Percent of Total	10^{15} Btu	Percent of Total	Percent Increase (1975-90)	Average Annual Percent Increase
United States	71	29	100	26	41	2.3
Other industrialized countries	67	27	125	33	87	4.2
Less developed countries	25	10	41	11	64	3.3
OPEC countries	6	2	15	4	150	6.1
Centrally planned economies	77	31	103	27	34	1.9
World	246	100	384	100	56	3.0

Source: U.S. Department of Energy figures as cited in Figure 13-33 in the Technical Report of the *Global 2000 Report to the President.*

ment for whom?" is sure to be a central one.

One major problem is that the world's finite fuel resources are not distributed evenly among nations or regions. Although increased oil exploration in some developing countries could step up their oil production, in others, hydropower and geothermal potential offer the possibility of expanded local generation of electricity. Growing crops for ethanol is also an option in some locations.

Nuclear power is high on the list of energy alternatives. In its present stage of development, however, it carries the risk of accidents leading to radioactive contamination of the environment and increased potential for proliferation of nuclear weapons. Nor are there adequate ways to deal with radioactive wastes.

Ultimately the world must rely on inexhaustible sources—solar, biomass, wind and tides, nuclear, geothermal, and hydro-electric energy. It must solve the technological, economic, political, and environmental problems involved in "getting there." But for the rest of this century, oil, natural gas, and coal—also burdened with political and environmental problems—will have to meet energy needs.

MINERAL RESOURCES

The nonfuel minerals on which modern civilization relies—iron, copper, lead, aluminum, and many others—have been extracted and consumed in the 20th century at rates which cannot be sustained indefinitely. Mineral deposits occur in the crust of the earth in finite amounts. Like oil and coal, minerals are non-renewable resources. These minerals are essential for modern manufacturing, transportation, and defense. While minerals are distributed widely throughout the world, only deposits sufficiently concentrated and accessible are economic to mine.

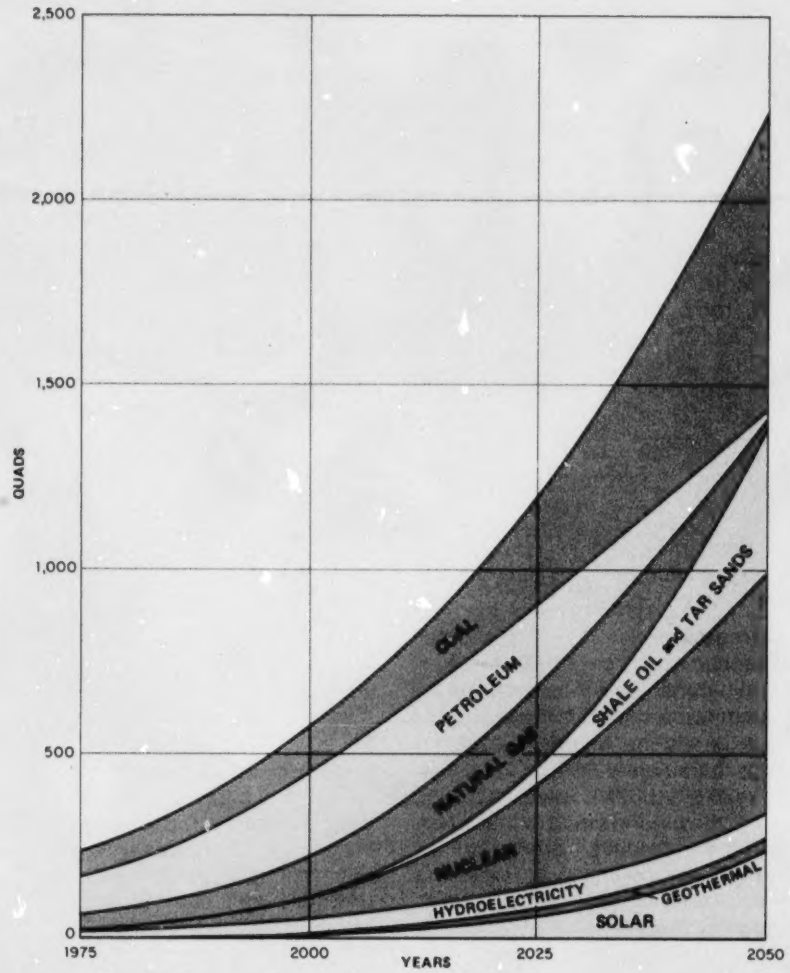
Global consumption of minerals is projected to increase in the coming decades, and is likely to double in the 1980-2000 period. Consumption of minerals involved in steelmaking is projected to grow at three percent annually. Minerals involved in the production of fertilizer are also likely to grow at three percent annually with consumption of phosphate rock growing at over five percent per year—the highest growth rate for nonfuel minerals.

Will there be enough in the future? The answer depends classically on supply and demand. While demand has risen sharply in this century and particularly in the last few decades, it is quite unlikely that the *rate of demand* will continue to increase in the coming decades. This is in part due to the fact that while population will continue to grow larger, the *rate* at which it is growing has slowed down. While developing countries will continue to experience rapid population growth, their incomes will still be low enough in the ensuing decades that their demand for resources will not yet constitute a major share of world consumption.

In the developed countries—which will continue to have the lion's share of both fuel and nonfuel minerals—the rate of consumption will slow as rates of both income and population growth slow. Thus it is probable that while consumption of mineral resources will continue to grow considerably, the amounts consumed in the next few decades will be lower than would be the case if the rates of increase in population and income continued to grow.

What about the supply side? If one assumes that demand for minerals will stay the same in the years to come, and that known reserves of the minerals will not increase, then one can calculate a life expectancy of those minerals. Using 1976 data from the U.S. Bureau of Mines, we find that iron will last almost 200 years and that aluminum in bauxite and chromium will last more than 300 years. Manganese will last close to 200 years. On the other hand, several minerals—

Figure 3. World Energy Consumption, 1975-2050



Source: Ridker and Watson. *To Choose a Future: Resource and Environmental Problems of the U.S., A Long-term Global Outlook*, 1980.
Note: A quad of energy equals 10^{15} British thermal units. This much energy could be provided by 172 million barrels of oil or 37.8 million metric tons of coal.

fluorine, silver, zinc, mercury, sulfur, and lead—have a life expectancy of less than 40 years.

Mineral Reserves

Such estimates of low lifespan are alarming; they are also misleading if taken literally. Future demand is flexible and so are reserves. By definition, reserves include only those minerals in known deposits that are profitable to mine under existing legal, economic, and technological conditions. They are not fixed amounts. Exploration and discovery of new mineral deposits are continually added to reserves. New uses for waste products of some ores can make previously unprofitable low-grade ores profitable to mine. New technologies can permit the extraction and processing of deposits that were impossible or uneconomical to exploit previously. For example, new techniques for mining manganese nodules in the ocean may greatly increase manganese reserves and reserves of other minerals as well.

Even if one were to use the absolute amount of minerals in the crust of the earth as the resource base on which to calculate mineral lifespans, the results would not be accurate. Unlike petroleum which is lost when burned, most minerals are not significantly diminished by use. Recycling of minerals can add substantially to future reserves.

Prices tend to rise as depletion of high grade reserves occurs, and poorer grades of deposits are mined and processed at greater expense in relation to the final product. At a certain point, these price rises will inspire the search for or development of alternate minerals or for replacement by synthetics such as plastics. Copper is increasingly being replaced by fiber optics in communications systems, reducing the pressure on copper reserves.

Thus absolute scarcity of nonfuel resources due to depletion is not a critical problem for the decades and probably the century to come. Demand will continue to grow, however, and it will be met through further explorations and discoveries, new technologies, recycling and conservation, substitutions, and synthetics. Prices of minerals will rise as energy prices rise; mining is energy-intensive and the more inaccessible and low-grade deposits require even more energy to extract.

While the activities mentioned above will provide minerals to meet the growing demand, we must recognize that they are—taken all together—necessary actions, not options. We have already exploited the richest and most accessible mineral deposits. If the developed world is to sustain a reasonable standard of living and the developing countries are to attain one, then these activities aimed at warding off depletion of needed minerals (or more accurately, warding off impossibly high prices to obtain them) must be undertaken. The boom times of cheap and easy-to-get minerals are over.

Efforts to increase reserves of needed minerals require large investments of money and time. These investments often do not pay off. In the U.S. the average time that elapses between discovery of a new mineral deposit and the beginning of production from the mine is eight years. Some of the delay is due to the environmental problems.

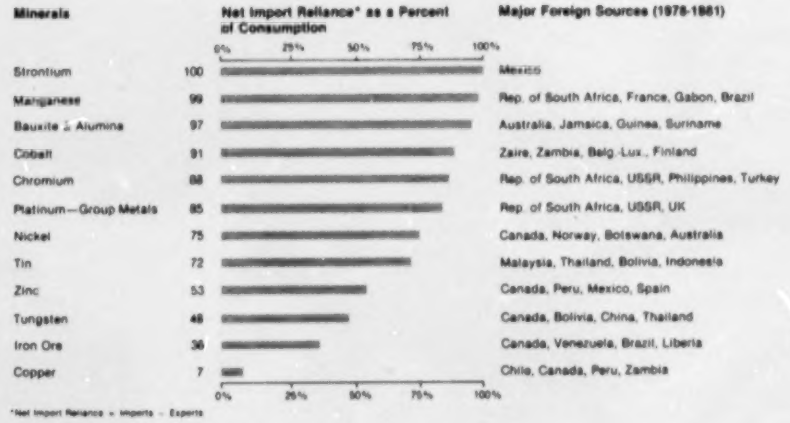
The mining of six minerals—iron, phosphorous, bauxite, manganese, copper, and chromite—accounts for more than 95 percent of mineral production. It is estimated that world production of these minerals will more than double by the year 2000. Since most of the mining operations are carried out at the surface, land use and restoration become critical problems. In addition, the impact of mining and processing on the atmosphere and water is extreme. Water, air, and noise pollution and solid waste disposal are persistent problems and expensive to solve. Mining of seabed minerals—a hope for the future—may pose the danger of significant oceanic deterioration with resulting damage to marine life.

Potential environmental problems and social disruption have led many communities in developed countries to veto mining or processing operations, giving the clear message: go elsewhere. These attitudes and environmental regulations will mean inevitable and costly delays. In developing countries which lack or have inadequate environmental safeguards, pollution problems have been and will be serious problems affecting health, farm productivity, and the general quality of life.

Distribution of Minerals

Aside from the problems associated with potential scarcity and pollution, there are problems associated with the uneven distribution and consumption of mineral resources. In most cases, the countries which possess the mineral reserves or process them are not the chief consumers. The quarter of the world's population living in the developed countries will continue to consume three-quarters of the minerals produced in the next two decades. Even the U.S., which is blessed by rich mineral resources, relies on imports for more than 50 percent of its mineral consumption. For western developed nations critical problems may arise because of dependency on many minerals from Communist East Europe, developing countries, and South Africa. Industrial countries currently hold 44 percent of the 20 most important minerals; 23 percent are held by Eastern European countries, and 33 percent by the developing countries.

Figure 4. U.S. Reliance on Selected Imported Minerals, 1982


Minerals
Net Import Reliance* as a Percent of Consumption
Major Foreign Sources (1978-1981)
0%
25%
50%
75%
100%
Strontium 100 Mexico
Manganese 99 Rep. of South Africa, France, Gabon, Brazil
Bauxite & Alumina 97 Australia, Jamaica, Guinea, Suriname
Cobalt 91 Zaire, Zambia, Belg.-Lux., Finland
Chromium 88 Rep. of South Africa, USSR, Philippines, Turkey
Platinum—Group Metals 85 Rep. of South Africa, USSR, UK
Nickel 75 Canada, Norway, Botswana, Australia
Tin 72 Malaysia, Thailand, Bolivia, Indonesia
Zinc 53 Canada, Peru, Mexico, Spain
Tungsten 48 Canada, Bolivia, China, Thailand
Iron Ore 36 Canada, Venezuela, Brazil, Liberia
Copper 7 Chile, Canada, Peru, Zambia
*Net Import Reliance = Imports - Exports

Source: Bureau of the Mines, U.S. Department of the Interior.

In addition, there are concentrations of certain important minerals in only a few countries. There are 15 minerals of which 75 percent of their reserves are found in only five countries. To complicate things further, mining is dominated by multinational companies. In times of shortages, these countries or companies have enormous power to raise prices or to discriminate against some customers and to favor others. Disruption of supplies due to political or economic discrimination is a real threat.

To summarize: easy-to-obtain, rich mineral deposits are dwindling, but new discoveries and technologies will increase the supplies. As energy prices rise, so will mineral prices. Needs for large amounts of capital investment, time lags, and environmental problems pose challenges. Perhaps the greatest challenge to mineral sufficiency lies in the fact that mineral supplies and processing are dominated by a few countries and multinational corporations.

FOOD

Perhaps nothing demonstrates the concept of interrelatedness as much as global food problems. Here population growth, the extent of arable land, farm management, science and technology, the price of oil, water availability, market prices, poverty, land ownership, government policies, and diets intertwine with each other and with a host of other factors.

The question, of course, is: will there be enough food to feed the world's population of six billion at the turn of the century? The answer is: yes, theoretically. Or the answer might be: on paper, there is enough or could be enough food to feed even the 10.5 billion forecast as the ultimate size of world population when it stabilizes in 2110 (U.N. medium projection).

Green Revolution

In the past few decades, worldwide food production has more than doubled. This is due to application of new scientific agricultural techniques and technology. The "Green Revolution" provided seeds which greatly increased the yield per acre (or hectare) for wheat and rice. These increased yields depend not only on the miracle seeds but on irrigation, specially formulated fertilizer, pesticides, herbicides—in short modern, high energy (oil) farming methods. Given the right seeds and application of these inputs and methods, wheat and rice yields can be two to three times greater than yields of traditional varieties.

India is a case in point. The new wheat varieties were introduced in 1966. By the early 1970s, wheat production had doubled to over 23 million tons. Indian scientists overcame a wheat disease called rust by developing new strains that resisted rust and matured earlier. By the 1978-1980 period wheat production was at 33 million tons; from being the world's second largest cereal *importer* in 1966, India had become self-sufficient by the late 1970s.

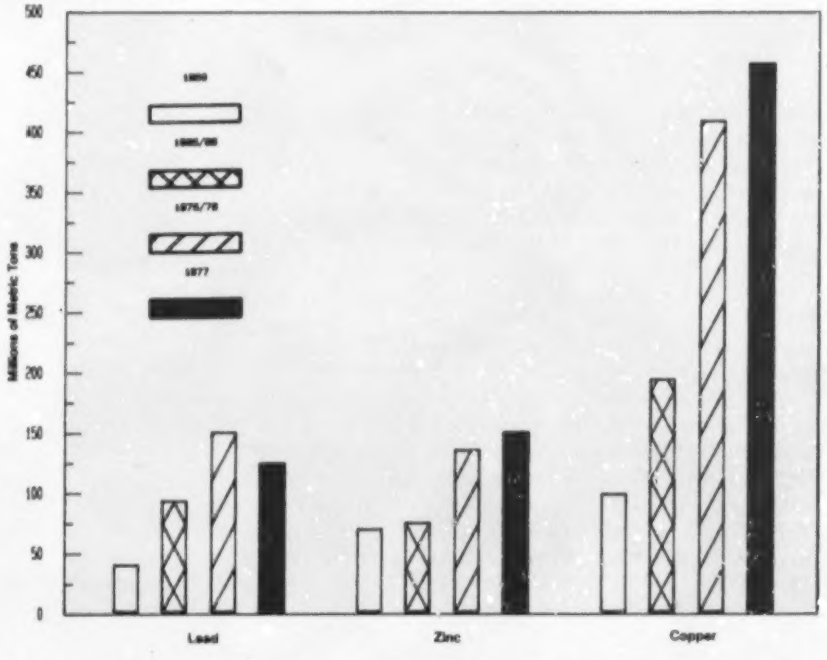
The new wheat varieties spread to many parts of the world. Among other countries, China, Pakistan, and Bangladesh produced impressive wheat crops. The new rice varieties were adopted in South Asia and Southeast Asia. These strains need just the right amount of moisture—they cannot be grown in heavily flooded areas and they must be irrigated during the dry season. Where conditions are right, the new rice varieties increase yields dramatically: their short growing time permits two and even three crops to be produced on the same plot of land each year. While not as dramatic as the outcome of research on wheat and rice, progress on maize, sorghum, and other food grains is being made.

While the Green Revolution is truly well-named, revolutionizing the lives of millions of farmers, many millions more have not benefited. The reasons include: 1) the price of the inputs was too high; for example, oil to run farm machinery or irrigation pumps; 2) the technology was not suitable for the particular climate and soil; 3) research was not available to adapt the international varieties of grain to local conditions; 4) adequate rainfall, irrigation, or flood control was not available; 5) transportation and marketing networks were inadequate to take advantage of the increased yields; and 6) the market prices for crops and other incentives were insufficient to motivate them to produce more crops.

Per Capita Production

Food production has indeed more than doubled during the past quarter century and is sufficient to feed every human being on earth an adequate diet. But the sad fact is that totals for the world do not reflect local realities. While some developing countries, notably in Latin America and South-

Figure 5. World Reserves of Selected Minerals, 1950, 1965/66, 1975/76, and 1977



Source: *Interfutures* (Paris, France: Organisation for Economic Co-operation and Development, 1979), Table 13, p. 44.

While the supply of minerals is not inexhaustible, new supplies are added to reserves through discoveries and technological advances.

east Asia, have made impressive gains, in others, food production has fallen below required amounts. Since 1960, the developed countries have produced far more food than its citizens could consume. The average citizen of these countries has a diet higher in calories and protein than required. But in the USSR and many developing countries, food production has failed to keep up with population growth and income growth (which increases the per capita demand for food).

In South Asia and Africa in particular, food production has not won the race with population growth. During the 1970-1980 decade, food output in Africa increased 1.6 percent but, because of population growth, the per capita production actually declined 1.1 percent. In South Asia, food production increased 2.2 percent during the 1970s but again because of population growth the per capita benefits were virtually wiped out. These failures are due to economic and institutional constraints (e.g., failure or inability of a developing country government to invest adequately in agricultural development), rather than to biological limits per se.

Within regions, and within countries, rates of food output vary. In India, for example, not all areas have the fertile soil, flood control, or drainage and irrigation systems necessary to produce the spectacular crop yields of the Green Revolution. Similarly, rates of consumption of food can vary widely within countries because of differences of purchasing power between the rich and poor of those countries. In some developing countries the *average* consumption of calories for the nation would have to be 10-20 percent above minimum levels to ensure that the poorest groups have diets that meet the minimum standards (as defined by the Food and Agriculture Organization of the United Nations).

While government policies and technological or institutional obstacles are largely responsible for food production rates that are less than they could be, poverty is the chief cause of hunger for individuals. Of course, rapid population growth in these countries increases the demand for food, and where it is not met, increases the absolute number of hungry people. Nonetheless, even with the rapid increases of population in recent decades, on a global level there is a sufficient quantity of food. People who can afford food buy food; the others are hungry.

There are hundreds of millions of poor people. Their diets are barely adequate and often in danger of disruption. Their incomes are so low that they can spend little on food, fuel, shelter, and clothing. The World Bank estimates that absolute poverty afflicts about 780 million people. If one includes as estimated 150 million poor people in China, then there may be a global total of close to one billion people living in absolute poverty.

The vast majority of the poor (over 90 percent) are rural dwellers who work on farms or do work that depends in part on agriculture. One-fifth to one-fourth of them are landless; the landless laborers are particularly vulnerable to bad times when their jobs are likely to disappear and they have no land to sell or mortgage for cash as a last resort. These people were the chief victims of famine when crop failures meant job layoffs in Ethiopia in 1973. In Bangladesh, a long period of flooding reduced employment of landless laborers and simultaneously, food prices rose. Thousands starved. Those who could afford the higher prices did not.

Ecological Considerations

The fact that hunger in the past and present is due to economic, political, and institutional obstacles, rather than to biological limits of food production, does not mean that there are no biological limits for the future. Nor does it mean that recent agricultural progress has been without its price.

Intensive application of the Green Revolution has produced spectacular results, but the early gains have not been sustainable; there is now a good but diminishing rate of return on the investment. The world's best arable land is already being farmed, although production could be boosted by extending the areas under irrigation. There are also large resources of *potentially* arable land in both developed and developing countries. Developed countries could increase arable land by close to 50 percent, and the developing countries taken together could almost double theirs. Much of this land, however, is subject to significant ecological constraints.

In addition, with the increase in world population and the scope and variety of economic activities, competition for the use of arable or potentially arable land is becoming keen. Residential, industrial, commercial, and recreational uses, transportation, mining and mineral extraction, and preservation of natural habitats compete with agricultural, pasture, and forestry uses.

The loss of productive soil is one of the most serious problems facing the agricultural future. It has several dimensions:

- deforestation, particularly in tropical regions. Because trees convert carbon dioxide to oxygen,

USDA Photo by Fred Taylor

Irrigation can make some arid land agriculturally productive.

the loss of large areas of forests could mean an increasing concentration of carbon dioxide in the atmosphere. According to some experts, the loss of the Amazon forests could increase global carbon dioxide by 10 percent with possibilities of climate changes unfavorable to agriculture. Deforestation increases flooding and erosion and causes sedimentation in fresh water and neighboring seas (in turn reducing fish catches).

- erosion of soil in both developing and developed countries. Erosion leads to a reduction in crop yields and an increase in energy use for agricultural purposes as farmers try to compensate for the reduction in the fertility of their soil. Desertification is a severe form of erosion which is reducing the amount of productive soil in many parts of the world. Africa and the southwestern United States are two examples. Serious erosion affects a large percentage of land in Bangladesh, El Salvador, and Haiti. It is a matter of increasing concern in the U.S., which may have lost 30 percent of its topsoil in the last 200 years.
- increase in the salinity and alkalinity of the soil from irrigation of fields. Improper watering—overwatering, for example—has meant the loss of productive soil in many parts of the world. Irrigation is also reducing rapidly the level of groundwater; the water table is almost irreplaceable once depleted because water infiltration is an extremely slow process.
- urbanization which results in the loss of millions of acres of cropland yearly. To keep up with food demand, increasingly fragile or marginal lands are turned to; these require expensive additions of fertilizer and other treatments. Loss of cropland to other uses is a serious problem in the U.S. on which much of the world depends for its grain. Given population growth and urbanization trends in developing countries, the continuing loss of fertile soils will be a great obstacle to achieving self-sufficiency in food. In Egypt, for example, urbanization has claimed as much fertile soil as the Aswan dam has produced in the past two decades through irrigation. Better land management would have meant a doubling of the fertile land in Egypt, had population growth been channeled into non-fertile areas rather than good arable land.

Table 2. Growth Rates of Food Output by Major World Regions, 1960-1980.

Region and Country Group	Food Output			
	Total		Per Capita	
	1960-70	1970-80	1960-70	1970-80
Developing countries[a]	2.9	2.8	0.4	0.4
Africa	2.6	1.6	0.1	-1.1
Middle East	2.6	2.9	0.1	0.2
Latin America	3.6	3.3	0.1	0.6
Southeast Asia	2.8	3.8	0.3	1.4
South Asia	2.6	2.2	0.1	0.0
Southern Europe	3.2	3.5	1.8	1.9
Industrial free market countries	2.3	2.0	1.3	1.1
Nonmarket industrial countries[b]	3.2	1.7	2.2	0.9
Total world	2.7	2.3	0.8	0.5

[a]Excluding China.
[b]U.S.S.R., Poland, Bulgaria, Hungary, Czechoslovakia, East Germany.
Source: FAO as published in the *World Development Report 1982* (Washington, D.C.: World Bank), Table 5.1, p. 41.

- Other problems include the abuse of pesticides which, in addition to the considerable expense, contaminates soils and foods, destroys pests' natural predators, harms non-pest species, and encourages the development of pesticide-resistant strains of pests. While some analysts believe high yields depend on pesticides, others say that the problems caused by their widespread use have wiped out their benefits. At the same time in impoverished areas, dung and crop residues are being burned for fuel instead of being applied to the fields as a natural fertilizer. The constant growing of one crop—monoculture—has posed another threat: vulnerability to disease or pests and destruction of needed genetic diversity for improving plant varieties in the future. The intensive applications of fertilizer and other energy-related inputs have not led to crop yields which are sustainable over a long period. According to some studies, land degradation due to one or more of the factors described above could, if continued, result in the loss of one-third of currently arable land by the end of this century.

Douglas Shane, National Museums of Canada

Deforestation often leads to flooding and soil erosion.

Fisheries

Economic, political, and biological constraints have slowed the growth of agricultural production worldwide. Many rightfully look to the world's fisheries as a partial answer to the world's food needs. However, the world harvest of fish is not expected to increase significantly by the end of the century. The world catch leveled off in the 1970s, and harvests of traditional fisheries might not be sustainable at current levels unless managed wisely. Pollution, overfishing, and destruction of marine and coastal ecosystems are the chief enemies of a healthy fishing industry. In addi-

tion to land-based sources of pollution and siltation, deep-sea mining could have serious adverse consequences on marine environments. There is hope that aquaculture—fish farming—could greatly increase the contribution to world protein supplies and krill, the abundant, tiny, shrimp-like shellfish of the Antarctic, might be harvested at least for animal feed.

Food Prospects

It seems clear that the future of agricultural and fishery production depends on good planning. It is, for example, far easier and cheaper to prevent further soil loss by adopting sound land management policies than to let productive soils deteriorate or be converted to other uses. In such cases, less fertile land must be farmed or remedial measures taken to increase fertility; these may exact too costly a price in both economic and environmental terms.

The developed countries have a vital role to play in assisting developing countries to develop, adapt, and apply modern, but ecologically sound, agricultural practices. Food aid and food relief for emergencies are important, but in the long run investments in agricultural development are more important.

Developing countries in turn must examine their policies which either encourage or discourage farming productivity, including setting the market prices for food products, investments in the agricultural sector, education of farmers, among many others. The problem of land ownership must be addressed as well; farmers work harder and produce more when they can reap the benefits of their labor. Since poverty is the root cause of hunger, meaures which raise incomes and which provide security for the poor will go a long way toward making famines a thing of the past. Reducing the rate of population growth will buy time for agricultural reform and will reduce pressure on land for competing purposes (e.g., urban housing, roads, mineral extraction).

OUR GRANDCHILDREN'S WORLD

Looking at the statistics and descriptions of trends contained in the major reports, one gathers a picture of the present and likely near-future. The picture shows the interrelated patterns of rapid population growth, energy supply problems, minerals in diminishing supply, and stubborn obstacles in achieving the goal of a

VISIONS OF ABUNDANCE—AND COMMENTS

While a consensus exists among the major world reports that problems are solvable, they all see extremely difficult times ahead economically and environmentally. There are dissenters to these conclusions, most notably Herman Kahn, Chairman of the Hudson Institute and Julian Simon, Professor of Business Administration and Economics at the University of Illinois—Urbana-Champaign. The following excerpts briefly illustrate their viewpoints but readers are advised to consult the Kahn and Simon books listed in the bibliography on page 13. Excerpts are followed by commentaries of demographers or economists.

Herman Kahn

"The basic message is this: Except for temporary fluctuations caused by bad luck or poor management, the world need not worry about energy shortages or costs in the future. And energy abundance is probably the world's best insurance that the entire human population (even 15-20 billion) can be well cared for, at least physically, during the many centuries to come." —*The Next 200 Years*, p. 83.

"....except for the occasional regional fluctuations caused by natural disaster, inappropriate policies or the misapplication of resources, the long-term prospect is for adequate food supplies. By 'adequate' we mean both an increasing amount of food per capita and an improving nutritional balance in the countries of the world currently deficient in either of these respects. Indeed, within 200 years we anticipate that—if desired—it will be possible to increase world food consumption to the level of the United States today (approximately 2,000 pounds per capita of grain equivalents annually)." —*The Next 200 Years*, p. 107.

"The dramatic increase in the [world population] growth rate which began in the seventeenth century became almost explosive during this century. It is believed to have peaked at around 2.1 percent during the mid-1960s, and is now at about 1.7 percent and rapidly declining. Barring some great change in current and likely trends it should ultimately produce another more or less static growth situation—a rough prototype of many current long-term growth trends." —*The Coming Boom*, p. 30.

Paul Demeny of the Population Council comments on Kahn's faith in super-technology as salvation:

> ...The new technologies promise to transform, for the better, energy production, food and agriculture, environmental protection, medicine and health care, and mass transportation. There are also promising vistas opened up by biotechnologies, space exploration, silicon chips, new materials, and by "automation of home, office and factory." The last, Kahn says, will lead to the development of computer networks: "C^{4}I^{2} systems," combining "command, control, communications, computing/information and intelligence."
>
> Unfortunately, tapping the dynamism of high tech presupposes successful solutions for many mundane economic problems underlying, or resulting from, the current malaise. The "grip of super-inflation" must be broken, the possibility of long-term "low-fixed rate" financing of capital investment must be reestablished. OPEC's capacity to do mischief must be checked, the tax system must be revamped, and "US defense postures" must be "revitalized." On each of these issues and their solutions Kahn has much to say that is illuminating and constructive, but the unintended cumulative effect is rather somber. As the argument progresses, the promised coming boom is likely to appear to most readers as less and less a near-certain prospect and more a special case of "lucking out."
>
> —*Population and Development Review*, Vol. 8, No. 4 (December 1982), p. 853.

To Kahn's views on population trends, Demeny responds:

> This grand and reassuring statement would leave most demographers less than satisfied. The 2.1 figure for the peak growth rate is almost certainly too high: 2 percent (or a shade below 2 percent) would be a more defensible estimate. The over-statement exaggerates the decline in the growth rate that has occurred. The claim of "rapid decline" as a general phenomenon is ill-founded. There is little or no evidence of decline in Africa and in much of West, South, and South East Asia. Few demographers would be surprised by an increase in the rate of population growth in China in the 1980s, or, for that matter, by an increase in the developed world."
>
> —*Population and Development Review*, Vol 8, No. 4 (December 1982), p. 854.

Julian Simon

"...In the long run, the most important economic effect of population size and growth is the contribution of additional people to our stock of useful knowledge. And this

contribution is large enough in the long run to overcome all the costs of population growth..." —*The Ultimate Resource*, p. 196.

"...And the more people, the more minds there are to discover new deposits and increase productivity, with raw materials as with all other goods, all else equal....So the major constraint upon the human capacity to enjoy unlimited minerals, energy, and other raw materials at acceptable prices is knowledge. And the source of knowledge is the human mind. Ultimately, then, the key constraint is human imagination acting together with educated skills. This is why an increase of human beings, along with causing an additional consumption of resources, constitutes a crucial addition to the stock of natural resources." —*The Ultimate Resource*, p. 222.

"In the short run, all resources are limited....Also in the short run there will always be shortage crises because of weather, war, politics, and population movements. The results that an individual notices are sudden jumps in taxes, inconveniences and disruption, and increases in pollution.

The longer run, however, is a different story. The standard of living has risen along with the size of the world's population since the beginning of recorded time. And with increases in income and population have come less severe shortages, lower costs, and an increased availability of resources, including a cleaner environment and greater access to natural recreation areas. And there is no convincing economic reason why these trends toward a better life, and toward lower prices for raw materials (including food and energy), should not continue indefinitely."

—*The Ultimate Resource*, p. 345

Garrett Hardin, Professor Emeritus in Human Ecology from the University of California–Santa Barbara, responds to Simon's contention that population growth increases our pool of creative people:

...Compulsive optimists say that society will solve its problems faster if it produces more people, more problem-solvers, faster. Ridiculous! England now has 11 times as large a population as it had in Shakespeare's day—but does it have 11 times as many Shakespeare's? Does it have even one Shakespeare?

The conditions needed for creativity of any sort are poorly understood, but there is no reason to think that an increase in the world's present population of 4.5 billion will produce any more problem-solvers. Classical Athens had only 40,000 free citizens, yet its intellectual creativity was a wonder. At high population levels interference phenomena inhibit originality."

—From a presentation at an American Association for the Advancement of Science symposium, January 5, 1982.

C. Peter Timmer, Professor of Agriculture and Business at the Harvard Business School, responds to Simon's assertion that population growth is a short-term (60 years or so) problem but a long-term blessing:

Policymakers and poor people alike live in the short run, where events several years off might as well be eternity. If no mechanisms exist for connecting the short run with the long run, then Simon's vision is not only utopian but pernicious because it raises our sights from the real problems of today to the future problems that—by his reckoning—inevitably solve themselves....

....for policies that affect the very poor in an adverse way in the short run, there may not be a long run. The survival of the very poor is precarious. They suffer from poor health, marginal food intake, very high rates of infant and child mortality, and significantly shorter life expectancy than their better-off countrymen, no matter what country. To help these people, policies must improve their lot in *both* the short run and the long run. This is a task that policy analysts and policymakers have shied away from for decades. Only recently has professional attention been focused on the dilemma itself. Simon's analysis runs completely counter to this effort. His faith that everyone will be better off in the long run is little solace to the several hundred million poor of the world who have no grounds for such optimism.

—*Population and Development Review*, Vol. 8, No. 1 (March 1982), pp. 164-165.

Timmer also replies to Simon's question about why people, scholars, and laypersons alike tend to be pessimistic about the future even though technology has improved people's lives over the past centuries:

...technology was oversold to the postwar world. Many people feel betrayed by the failure of technology to solve some very pressing problems—from traffic congestion and public transportation to global poverty and hunger. We were promised space-age subways and miracle rice, but the doors refuse to open and the hungry continue to suffer in the midst of plenty. A "technological fix" used to be a magic solution; it now carries the connotation of an unthinking and ultimately unworkable approach to complicated problems.

—*Population and Development Review*, Vol. 8, No. 1 (March 1982), p. 167.

decently nourished world by the end of the century. The condition of forests, water, air, wildlife, genetic diversity, and other natural systems are also intertwined with the efforts to support an increasingly modern way of life for a large and increasing number of human beings.

The picture is a sober one, but the reports do not conclude that the earth is in an irreversible downward spiral. If the record of the last two centuries, and particularly the last two decades, shows greed and heedlessness, it also shows awe-inspiring human ingenuity and problem-solving. Technology has caused problems but it has produced achievements in food production, transportation, communications, housing, and general comfort that our ancestors could not imagine. And while war, poverty, racism, and injustice have survived the ages, the collective conscience of human beings has made some progress toward cooperation and compassion. It is a mixed picture.

If one can admit the mixture of virtue and vice in human activities, then one need not choose between the optimistic or pessimistic schools of considering the future. They both are right to a degree and wrong to a degree.

Optimism or Pessimism?

The optimists point to previous prophecies of doom and show that they were wrong. New inventions and technologies averted the disasters predicted. While they are right to celebrate human ingenuity, they are wrong to assume that because some past prophecies were wrong, all current warnings about the future are ill-founded. Because disasters were averted in the past does not contradict the possibility that some problems if uncorrected can lead to future disasters. It is as naive a belief as that of an individual 95 years of age who believes he will not die because he hasn't ever died.

On the other hand, the pessimists do an equal disservice by painting a picture of coming disasters so enormous that human intervention can do little to alter the course of events. Such depictions lead to a sense of helplessness. The motivation to solve the problems is seriously weakened. "We are doomed" becomes a self-fulfilling prophecy.

While the reports vary somewhat on the optimistic-pessimistic scale, there is a consensus that there is

much that can be done to correct the problems they describe. The rate of population growth is slowing down and the decline could be accelerated through expansion of family and population planning programs and indirect measures, such as increasing educational and employment opportunities for women. Mineral and energy needs can be sufficient in the future if carefully managed. Food production can be increased if modern and ecologically sound, sustainable farming methods are adopted worldwide.

The most stubborn problems are the political and economic ones. If adopting ecologically sound farming methods means reduced profit in the short term for the farmer (big or small), will the less profitable method be adopted? Will it take legislation to ensure adoption of such practices? Would such legislation ever be passed if there are strong economic interests arguing against it? Such questions could be posed for farming, forestry, fisheries, water management, mining, energy, and other trouble spots.

A Global View

Of course a global view is necessary, an environmental ethic that transcends national boundaries and a sense of justice that rises above the profit motive. Citizens in democracies must strive to elect legislators who see the interdependence of nations and who want to protect the earth for future generations. They must try to influence current legislators as well. Citizens in non-democratic nations must also try to encourage their governments to take a global view as well. And citizens everywhere must work for improvements in their own "backyards." "Think globally; act locally" is a good starting point.

We turn increasingly to the international agencies like the United Nations and the World Bank which can in their activities rise above national borders to take the larger view. Imperfect as they are, such international agencies and special topic meetings (such as the Law of the Seas Conference), offer special hope for solving environmental and economic problems. The staffs and financial resources of the international aid agencies can be increased to help meet the demand for assistance from developing countries. Their policies, like those of individual nations, must emphasize development which is sustainable and ecologically sound. These policies must consider how it can best help the poor and women. It may be that some of the most creative solutions will find ways to deal with problems in harmony with the profit motive, and perhaps because of it.

A major lesson emerges: that solutions to problems sometimes bring equally great problems. To increase crop yields through heavy applications of pesticides and fertilizer may lead to pollution of fisheries through run-off water. The burning of coal and other fossil fuels, as a solution to diminishing oil supplies, produces acid rain with its negative effects on crops and lakes. Rapid population growth puts pressure on the land for housing and other urban uses, diminishing in many cases the amount of arable land needed to feed that very population. Everything is connected to everything else. Whatever national leaders or international agencies are "in charge," they must be aware of the dynamic links among population growth, energy, minerals, food and hunger, air and water quality, and the economic and social realities that govern human interactions. The ordinary citizens who influence their national and local governments must also be aware of the interrelatedness of the world.

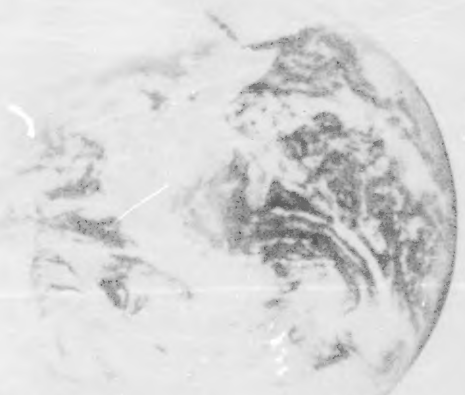
Harlan Cleveland in his foreword to *Ominous Trends and Valid Hopes* wrote:

> In the short run—the next two or three decades—the human environment will deteriorate in all sorts of more or less predictable ways. The policy question is whether things will get worse before they get even worse, or will get worse before they get better. And that depends, I repeat, less on Nature than on us.[2]

In an earlier day—December 10, 1950—William Faulkner in his Nobel Prize acceptance speech revealed the tenacity of the human spirit in the face of adversity:

> I decline to accept the end of man... I believe man will not merely endure: he will prevail.

[2]Magda Cordell McHale, *Ominous Trends and Valid Hopes: A Comparison of Five World Reports* (Minneapolis, Minn.: University of Minnesota, 1981), p. iii.



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The Ultimate Resource by Julian L. Simon. Princeton, New Jersey: Princeton University Press, 1981.

U.S. Carrying Capacity: An Introduction by Maryla Webb and Judith Jacobsen. Washington, DC: Carrying Capacity, Inc., 1982

"World Food Resources and Population: The Narrowing Margin" by Lester R. Brown. *Population Bulletin* Vol. 36, No. 3. Washington, DC: Population Reference Bureau, 1981.

World Population: Toward the Next Century by Elaine M. Murphy. Washington, DC: Population Reference Bureau, Inc., 1981.

The 1982 World Population Data Sheet by Carl Haub. Washington, DC: The Population Reference Bureau, 1982.

Publications on population, the environment, and natural resources are available at low or no cost from many organizations. See the following directories for listings of such organizations.

The Conservation Directory 1983. Edited by Jeanette Bryant. National Wildlife Federation, 1412 16th Street, N.W., Washington, D.C. 20036.

Directory of the Population-Related Community of the Washington, D.C. Area. Edited by Ann Hammond. Population Reference Bureau, 1337 Connecticut Avenue, N.W., Washington, D.C. 20036

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